Ecological Land Classification of Big Hill Springs Provincial Park

Alberta
ENVIRONMENTAL PROTECTION

NATURAL RESOURCES SERVICE
RESOURCE INFORMATION UNIT
BOW REGION

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ECOLOGICAL LAND CLASSIFICATION OF BIG HILL SPRINGS PROVINCIAL PARK, ALBERTA

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1.0 INTRODUCTION

Big Hill Springs Provincial Park was established in 1957 to conserve a unique coulee environment and spring-fed creek system (AEP - Park File). In years since, a number of specialists and organizations have documented various aspects of the Park's resources including archaeological – cultural (Glenbow Foundation; University of Calgary: Park File), ecological (Wallis and Wershler 1972), hydrogeological (Curcio 1967, 1970; Borneuf 1983; Houseknecht 1984; Komex 1998), botanical (AEP 1994), and wildlife (Calgary Field Naturalist's Society).

The Park's landscape features contribute significantly to under-represented Natural History Themes in the Foothills Parkland Natural Subregion (Report 3: Alberta Protected Areas System Analysis [1994]; Alberta Environmental Protection, Edmonton).

A Park Management Plan (AEP 1996), currently at draft stage, raises a number of conservation issues and objectives, many of which are addressed in this update and synthesis of biophysical information, including:

- preservation of natural environment, features, species, and habitat;
- natural history interpretation;
- water quality and quantity;
- creekbank management;
- improvement of facilities and infrastructure (e.g. picnic sites, roads, trails);
- accommodate recreational activities;
- acquisition of select adjacent parcels of land;
- boundaries and fencing.

In this context, the overall objectives of this study were to:

- Complete a review of existing biophysical information;
- Conduct a biophysical inventory to current standards and scope;
- Conduct an analysis of any significant changes.

Secondary objectives included:

- Obtain new aerial photography of the Park and surrounding lands;
- Conduct an intensive baseline study of the springs and associated features;
- Make management recommendations.

2.0 STUDY AREA DESCRIPTION

2.1 Location

Big Hill Springs Provincial Park is located in the Big Hill Creek valley 15 km north of Cochrane in the north half of Section 29, Township 26, Range 3, west of the Fifth Meridian. It is accessible from Secondary Highway #567, east of the Junction with Highway #22 (Map 1).

It is situated, for the most part, in a side-coulee which leads from the Big Hill Creek valley and covers 32 hectares (AEP 1996) or 79 acres. Presently, the Park is distributed over two disjunct parcels of land – the main part established in 1957, and a 6-hectare parcel in the northwest corner of Section 29 (identified as the "northwest parcel" in this report) at the head of the coulee, acquired recently to preserve the primary springs. The two parcels are separated by about 150 meters of private land (Map 2). A full legal land survey has not been conducted to this point, and boundaries, fencelines, and area measurements are therefore approximate.

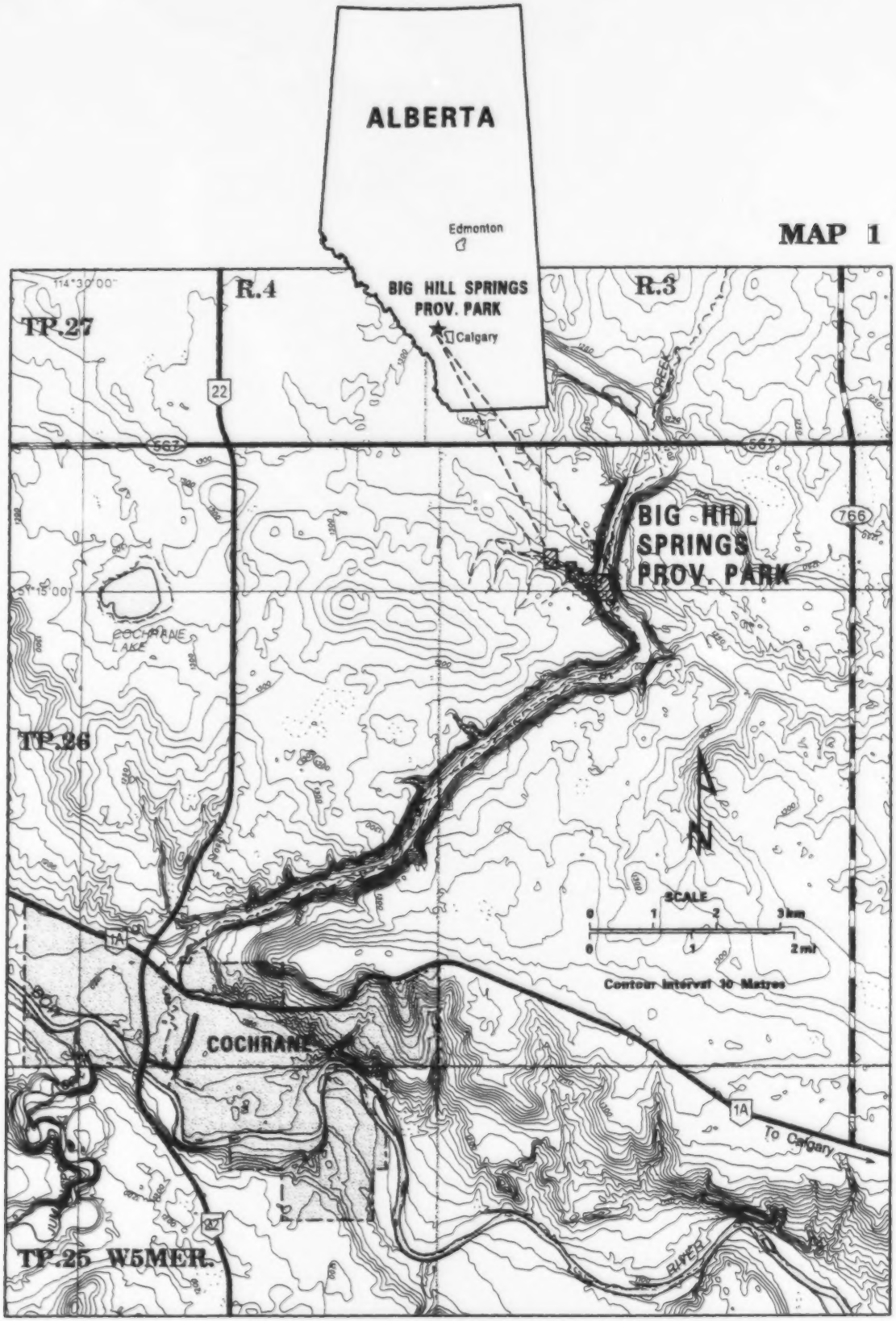
Biogeographically, the Park is in the Foothills Parkland Natural Subregion, at the northern end.

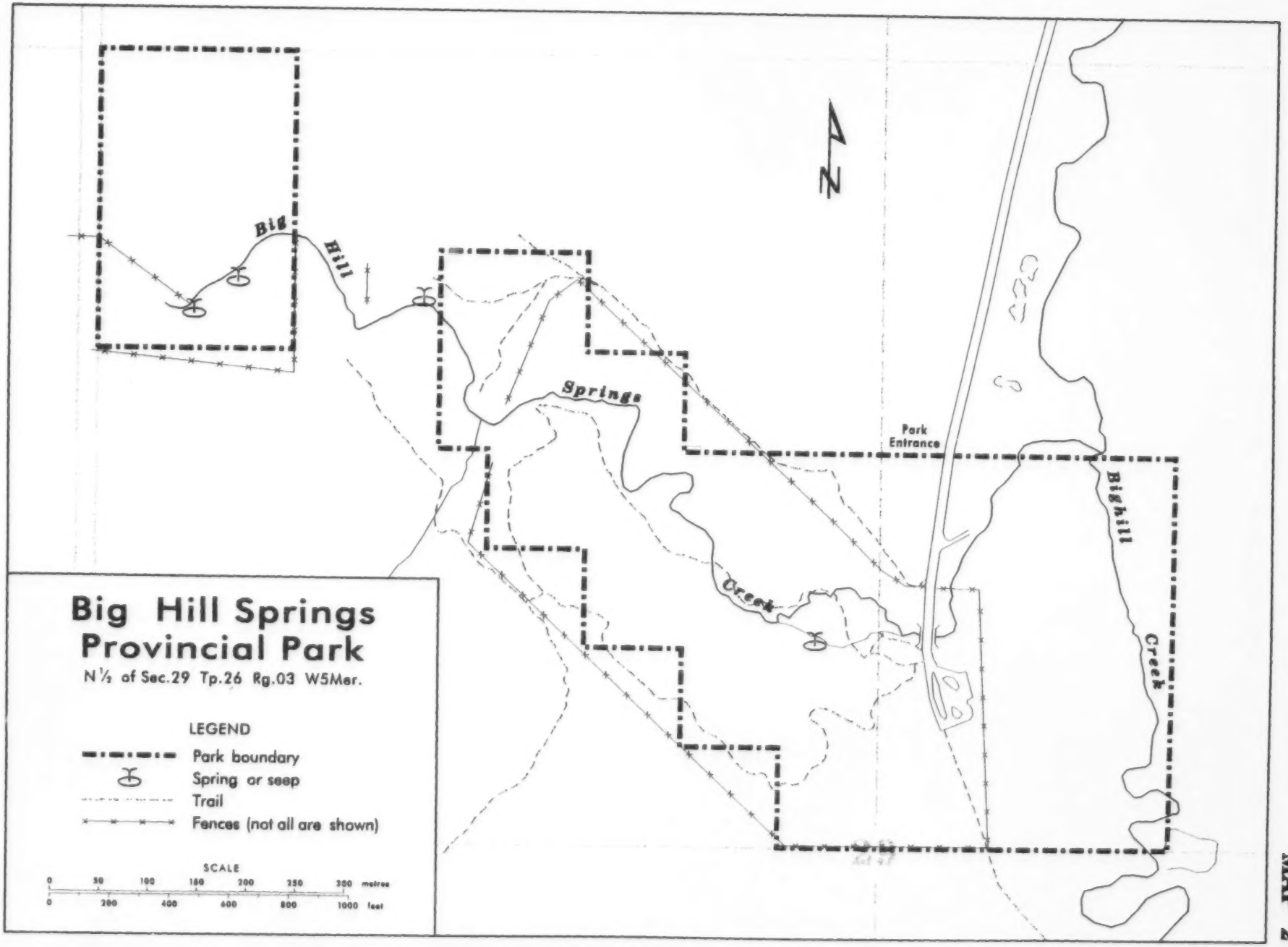
2.2 Land Use History

A constant source of water has long attracted people and wildlife to the Big Hill Springs area. Plains Indians hunted bison (evidently using the "jump" method) and camped near the springs (the AEP Park File documents findings of bone fragments and lithic tools). Lamoureux (1983) lists a "major" kill site and evidence of pictographs at Big Hill Springs, and "maybe" a major jump on the east face of Big Hill Springs coulee.

Ranchers arrived in the 1880's to graze and water their cattle. [An anecdotal, but detailed history from this point to about 1970 is included in the Park File (AEP).] Industrial interest in the springs and creek began before the turn of the century: a creamery was in operation from 1891 to 1910, and a trout hatchery was tested in the 1951-1956 period.

Recreation, mainly picnicking became popular in the 1920's and today is now the prime use of the area around the springs. Big Hill Springs Provincial Park was established in 1957. Increased visitor volume, heavy use, and environmental degradation into the 1970's raised concerns among park officials, and was the impetus for early biophysical data collection and management planning (Alberta Recreation and Parks 1988; AEP Park File). In 1976 the Park was proposed for designation as a Preservation Park, and many conservation initiatives were tabled (Blogorodow 1976). A reconfiguration to "day use only" began in 1978-79 with the removal of an array of visitor services and facilities (park ranger, campground, playgrounds, roads, picnic sites, and electricity) and


ALBERTA
Edmonton
Calgary
BIG HILL SPRINGS PROV. PARK
MAP 1
R.4
R.3
TP.27
TP.26
TP.25 W5MER.
BIG HILL SPRINGS PROV. PARK
COCHRANE LAKE
COCHRANE
22
567
766
1A
27
To Calgary
SCALE
0 1 2 3km
0 1 2mi
Contour interval 10 Metres
N


Big Hill Springs Provincial Park
N½ of Sec.29 Tp.26 Rg.03 W5Mer.
LEGEND
Park boundary
Spring or seep
Trail
Fences (not all are shown)
SCALE
0 50 100 150 200 250 300 metres
0 200 400 600 800 1000 feet
N
Big Hill Springs Creek
Park Entrance
Highway 22
Bighill Creek

MAP 2

reclamation of the sites. Day use exploration by visitors has affected the Park in terms of compacted , eroded, and denuded trails and paths (Alberta Recreation and Parks 1988). Today the facilities maintained include a parking lot, small picnic site, toilets, garbage bin, water well, and improved trails and footbridges.

Cattle ranching is the main land use in the surrounding area and at some sites within the Park under arrangements with a local rancher.

2.3 Climate

The Parkland Natural Region forms a biogeoclimatic transition zone between the drier grasslands of the plains and the moister coniferous forests of the Rocky Mountains. Mean annual precipitation is approximately 500mm in the northern part. Mean May to September precipitation is 290mm. The mean January temperature is -10°C and the mean July temperature is 14°C. The mean May to September temperature is 12-13°C and the frost-free period averages 90 days (Achuff 1994).

Conditions specific to the town of Cochrane, 8km to the southwest, are:

Temperature - Seasonal Averages	Jan. -11.8°C; April 3.3°C; July 16.4°C; Oct. 5.5°C
Frost Free Days	112
Annual Precipitation	50cm ; Rain: 28cm
Hours of Sunshine/year	2314

(from Town of Cochrane - Website Page 1997)

2.4 Hydrology

The hydrology and associated landforms are very distinctive and comprise a primary natural history theme of the Park (Lamoureux 1983). The Park is situated at the confluence of the spring-fed, first-order Big Hill Springs Creek and the somewhat larger Big Hill Creek , which flows down a glacial meltwater outlet from the township to the north, southwards to the Bow River at Cochrane (Map 1). Surficial drainage of the surrounding benchlands is either towards the ravine or into Big Hill Creek valley itself.[1]

The Park is located in a groundwater discharge area, creating many springs and seeps, as well as unique hydrological conditions and features. The springs provide lower Big Hill Creek with its year-round source of water (Lamoureux 1983). The hydrology of the springs and Big Hill Springs Creek is treated more thoroughly in Komex (1998).

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[1] Use of names and spelling of these creeks and valleys has been inconsistent. National (i.e. NTS) and provincial records and maps indicate **Bighill** Creek, but the spring-fed creek is officially unnamed (Alberta Environmental Protection, Resource Data Division; NAD83 Listing of Named Geographic Features 1997/02/12). The Park Management Plan (1996; in Draft) itself variously uses Big Spring Creek/coulee and Big Hill Spring Creek/valley; and Big Hill valley. Names used in this report (as per Alberta Recreation and Parks 1988) reflect widely-used colloquial versions.

2.5 Physiography and Bedrock Geology

Big Hill Springs Provincial Park is located at the western edge of the Interior Plains physiographic region where it meets the foothills of the Cordillera. The Interior Plains are composed of relatively undisturbed Phanerozoic sedimentary rocks, and in the Park the uppermost rock units are continental deposits of the Tertiary Porcupine Hills Formation overlying the Tertiary-Cretaceous Paskapoo Formation. These sediments were deposited as a result of erosion of the uplifting Rocky Mountains and foothills (during the late Cretaceous to early Eocene), and eastward transport of the sediments to form alluvial fans, stream, and lake sediments of the Alberta Syncline. As the sediments were deposited, the marine conditions that had dominated North America up to the end of the early Cretaceous were gradually replaced by continental conditions.

The (sedimentary) lithology of the Porcupine Hills Formation is sandstone (greywackes and sub-greywackes) and siltstone with minor shale. Significant outcrops are visible along ridges and valley walls throughout the area. The formation is composed of detrital quartz, chert, non-volcanic rock fragments and clastic carbonates (Yoon 1977; Park File).

2.6 Surficial Geology and Soils

During the Pleistocene Epoch, the Laurentide continental ice sheet advanced southward from the Hudson Bay and coalesced with the eastward-advancing Cordilleran ice sheet west of Calgary in the Big Hill Springs area. Deposition of glacial drift (till) and subsequent glacio-fluvial erosion modified the pre-existing land surface (Yoon 1977: Park File).

During glacial retreat about 10-12, 000 years ago, meltwater from the decaying ice margin to the north and east flowed into local topographic lows and deeply eroded the till blanket and soft underlying sandstone bedrock to create the Big Hill and Big Hill Springs coulees (Moran 1986; Alberta Recreation and Parks 1988).[2] The massive erosional process exposed underground aquifers, creating springs at a number of sites (Alberta Recreation and Parks 1988).

Today, the Park's complex and dramatic landscape can be considered composed of four primary elements:

- Till-blanketed Uplands. Moran (1986) describes this area as part of a larger unit of Spy Hill Drift (pebble-loam till) over the Porcupine Hills Formation sandstone. Found along upper south bank of the Big Hill Springs coulee, and extending to the south, the

[2] "Coulee" is used synonymously and interchangeably with "ravine" and "valley" in most instances here. According to Caboue (1996) it's a western Canadian term for a steep-sided prairie valley, but also refers to a broad-bottomed one of *glacial meltwater origin*, or to v-shaped gullies caused by more recent erosion.

moderately sloping, undulating benchland is about 1265m AMSL. Soils found at benchland sites were were fine to medium-textured (clayey), mainly weak-profiled Calcareous Black Chernozems, and often gravelly-cobbly.[3]

• Glaciofluvial Terrace. The north bench above Big Hill Springs coulee is a glaciofluvial terrace about 30 meters below the morainal benchlands of Section 32 to the north.[4] Of till parent material like the surrounding benchlands, soils found were fine to medium textured (clayey), mainly weak-profiled Calcareous Black Chernozems, and often gravelly-cobbly.[5] Orthic Black Chernozems may be found in cultivated sites (tame pastures).

• Coulee Walls. The banks range from about 65m high in Big Hill valley to 15m high near the upper end of Big Hill Springs coulee, and range from 35-80% slope.[6] Moran (1986) describes them as eroded bedrock outcrops of the non-marine Porcupine Hills formation, although at Big Hill Springs they are largely mantled with residuum, colluvium, or thin unconsolidated till veneers (Turchenek and Fawcett 1994). The dramatic, near-vertical bedrock face on the east bank of Big Hill Creek coulee towers just above – and outside - the Park's east boundary. Other smaller bedrock exposures are found in the Big Hill Springs ravine, mostly too small to map or indiscernible on airphotos. Slope failures (slumps and creep) are evident at many steeper sites, attesting to the generally weak bank stability afforded by the bedrock and till mantles in the area.

Significant ecological differences occur between the north and south-facing slopes in the highly incised Big Hill Springs Creek ravine. Slope, aspect, angle, and slope position are key determinants. Soils found on the heavily vegetated north-facing slope included primarily medium-textured (clay loams) and weakly developed or eroded Calcareous Black Chernozems with some Orthic Eutric Brunisols. On the south-facing bank, soil development appears minimal due to gradient, soil drainage, and insolation. Medium to coarse-textured Orthic Regosols were found on steep middle and upper slopes, and medium-textured Calcareous Dark Brown Chernozems on shallower, more vegetated lower slopes. In the Big Hill coulee, with moderately vegetated banks oriented east and west, soils on lower and mid-slopes tend towards Chernozemic (e.g. weakly-developed or eroded Orthic Blacks) in mainly fine to medium-textured colluvium.

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[3] Soils nomenclature and terminology is according to the Canadian System of Soil Classification – 2nd Edition; by Agriculture Canada, Pub. No. 1646 (1987).

[4] An identical - and intersecting - feature is found above the east boundary of the Park in Big Hill Coulee. Bedrock control (i.e. fault-lines) likely accounts for the remarkable linearity of their outer risers or scarps.

[5] Turchenek and Fawcett (1994) describe a landscape unit with *glaciolacustrine* veneer and some poorly-drained soils (Dunvargan-Maycroft) along the back of the terrace, extending slightly into the Park at points near the escarpment along the stepped northern boundary.

[6] Lamoureux (1983) states that Big Hill coulee is the most deeply-incised glacial meltwater channel in the region, and is recorded as an Environmentally Significant Area for this and other biophysical reasons.

• Valley Bottoms. The floor of the Big Hill coulee is about 1200m AMSL, with relief nearly level at 2.5% towards the east (Big Hill Creek) and south. Moran (1986) and Turchenek and Fawcett (1994) classify this area as a silty-clayey fluvial floodplain. Although MacMillan (1987) calls the parent material here "recent lacustrine" in a depressional area, the specific physical characteristics remain undisputed.[7]

Coarse fluvial deposits from Big Hill Springs Creek overlie most of the Big Hill coulee within the Park boundary. A classic raised alluvial fan has formed, deflecting the normally meandering Big Hill Creek with comparatively erosion-resistant materials, over time, against the east coulee wall.[8] Fluvial gravels in this feature are concentrated upslope (underlying the vicinity of the parking lot), and finer sediments downslope, towards the creek. Fans have formed at the bases of other nearby ravines and draws to the south, down the valley, and influenced the course of Big Hill Creek at those sites.

The forested Big Hill Springs ravine bottom, downcut in the old spillway, rises more steeply, about 5%, to the northwest and has numerous relict channels, terraces, and tufa deposits (Komex 1998). Soil types found in depressional sites like ravine floors reflect the effects of relatively fine-textured fluvial parent materials, low gradient, moist water regime, and typically lush vegetation. Medium-textured colluvium (at the edges) and alluvium (in the floodplain) are found in both valleys. Primary alluvial soils are Humic and Cumulic Regosols, sometimes gleyed, and Calcareous or Orthic Black Chernozems at raised and grassier sites.

Elevation within the Park boundary ranges from 1198 meters (AMSL) at the banks of Big Hill Creek, to 1272 meters on the highest benchlands above Big Hill Springs ravine.

2.7 Vegetation

The Foothills Parkland Natural Subregion generally forms a narrow transitional band between the grasslands of the Foothills Fescue Subregion and the forests of the Montane Subregion (within the Chernozemic soil regime). Desiccation by wind and low precipitation appear to be the main factors determining the extent of this Subregion.

Affected by topography and climate, there is a rapid transition from grassland with groves, to forest with grassy parks, to closed deciduous forest (Achuff 1994). This northern and largest segment of the Foothills Parkland is called the Black Diamond Upland ecodistrict, and characterized vegetatively as cleared land and shrub (Strong 1995). Strong (1992) and others contend that European settlement of the Parkland Natural Region reduced the normal frequency of fire, allowing former grasslands to be

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[7] Cauboue *et al* (1996) defines the sequential events of lacustrine deposition followed by partial reworking by fluvial processes as "fluviolacustrine", appropriate where Big Hill Creek has meandered through.

[8] Airphoto interpretation suggests that, under historical flow and deposition regimes, Big Hill Springs Creek should gradually migrate westwards, along the roadway, and that the confluence with Big Hill Creek will move northwards around the expanding fan. No changes in streamcourse were apparent between the 1985 and 1997 airphotos.

encroached by aspen and deciduous shrubs from the foothills. Today, little native grassland exists, having been encroached or replaced by crops and tame forage species.

Despite the extensive agriculture in the area, Big Hill coulee remains integral to a linear system of diverse green space environments extending from the Bow Valley to Highway 2 (which includes other coulees, valleys, and an abandoned railway line). Lamoureux (1983) recommends it as an "Environmental Priority Area", and AEP (1997) identifies it as an extensive Provincial Environmentally Significant Area (ESA).

This vicinity near Calgary has recorded some of the most northerly occurrences of *Lupinus* spp. (lupines), *Danthonia* spp. (oat grass), and *Festuca idahoensis* (bluebunch fescue) (Achuff 1994).

The Park, at some sites used heavily by visitors prior to 1979, has undergone significant artificial revegetation with native and introduced species. Lin (1980) describes landscaping, sodding, seeding, tree planting (aspen and white spruce), shrub planting ("golden" willow and dogwood), maintenance, and other reclamation / rehabilitation activities during 1979-80. A large grove of *Caragana arborescens* (common caragana) and some *Syringa villosa* (late lilac) remains at the reclaimed site of a former park warden's cabin. AEP (1994) notes the occasional presence of honeysuckle cultivars, and two widespread tame forage species, *Medicago sativa* (alfalfa) and *Phleum pratense* (timothy), probably spread from nearby pastures by winds and cattle.

2.8 Wildlife

An extensive list of animal species, primarily avifauna, observed in the Park can be found in Wallis and Wershler (1972).

Spalding (1980) states that the Richardson's ground squirrel (also inventoried by Wallis and Wershler) is the most frequently seen mammal in the area, and that mink have also been observed. According to both references, common birds include the Savannah sparrow, Cedar Waxwing, Western Meadowlark, and Common Yellowthroat. Other noteworthy birds in the vicinity of the Park are the Great Blue Heron, Cooper's Hawk, Prairie Falcon and Ruffed Grouse.[9] Of these, the Cooper's Hawk is considered rarest (Semenchuk 1992). Recent sightings of 132 bird species by members of the Calgary Field Naturalist's Society in and near the Park are listed in Appendix 2. At least 21 of the species were apparently breeding in the area (evidenced by nests, fledglings, breeding pairs, and courtship and distraction displays). Two species listed are endangered: Piping Plover and Peregrine Falcon. Some mammal, reptile, and insect observations are also listed in Appendix 2. Beaver activity (new dam and lodge), not mentioned in reference materials, was observed just beyond the southeast corner during field checks in May, 1998. The dam backed-up Big Hill Creek in the Park.

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[9] Draw sites (small, shallow ravines) on the southwest side of the Park, were reported in 1974 to have up to three grouse lecks (AEP-Park File).

Lamoureux (1983) suggests Rainbow trout or Rainbow-Cutthroat hybrids may be present in Big Hill Creek as far upstream as the Park, since populations have been noted less than a mile to the south in wider reaches.

The Parkland has experienced significant habitat "fragmentation" from agricultural expansion. This has especially impacted forest-dwelling birds (AEP 1997).

3.0 METHODS

3.1 Field Survey

Initial stratification of the study area and selection of field sample sites was performed on 1:5000 panchromatic aerial photos taken on May 1, 1985 (i.e. leaf-off). Airphoto interpretation delineated ecological units that were distinctive by their geomorphic and vegetation patterns. Representative field sites were selected to identify and document, on standard field plot forms, the range of landform, soil, and vegetation conditions across the study area.

Field survey was carried out in early July 1997 (with some follow-up fieldwork in late September) according to methods and guidelines in the Ecological Land Survey Site Description Manual (CAPAF 1994). A total of 29 diverse sites throughout Big Hill Springs Provincial Park were visited on foot and documented.

A study of the Park's hydrogeological characteristics and features, including the springs and creek was conducted at the same time under contract by Komex International Inc. of Calgary as a special component of the overall biophysical inventory. The study report is referenced as Komex, 1998.

Plant taxonomy follows Moss (1983) with common and scientific names referencing the Alberta Plants and Fungi Master Species List and Species Group Checklists (AEP 1993). Soil and landform terminology and classification used in this study are from CAPAF (1994), Cauboue *et al.* (1996), and the Canadian System of Soil Classification (CSSC) by the Agriculture Canada Expert Committee on Soil Survey (1987).

3.2 Data Analysis

A list of 126 species of vascular plants (excludes mosses and lichens) was compiled from field sampling, and is included as Appendix 1. The list is generally consistent with those in AEP (1994) and Wallis and Wershler (1972) . Differences could be attributed to the number and variety of sites visited as well as to plant phenology during each survey,.

These vegetation data were analysed and grouped into community types according to the "tabular method" described in Chapter 9 of Mueller-Dombois and Ellenberg (1974). This

method of floristic classification emphasizes dominance, constancy, and diagnostic or differentiating species in determining plant associations.

3.3 Ecological Land Classification and Mapping

The ELC is a hierarchical landscape classification and mapping system that subdivides the land surface into units with similar environmental / biophysical components. The map units that result from this process are characterized by distinctive recurring patterns of surficial material, landform, soil and vegetation. It serves, by means of data *interpretation* and analysis, to describe *typical* conditions and to generalize or simplify the landscape into units that may receive the same management.

New aerial photography of Big Hill Springs Provincial Park was acquired in June and July 1997 at scales of 1:5000 and 1:10 000. Subsequently, the ELC polygons were transferred from the 1985 photos to the new ones, with minor changes according to differences in vegetative cover evident on the 1997 coverage. Terrain, soils and vegetation data from the field sample sites were synthesized and used to develop the ELC scheme and to refine the polygon boundaries.

Map unit descriptions appearing on the ecosite (ELC) map (Map 4) represent the Ecosite level of the hierarchical classification system. This structure embraces the over-arching biophysical characteristics documented for the Natural Regions and Subregions (Achuff 1994), for their more local Ecodistricts (Strong 1995) and from airphoto and field data.

3.4 Ecosite Legend

Individual ecosite classes are described in spreadsheet format in Appendix 3. The study area lies within the Foothills Parkland Natural Subregion (#14) , and more specifically the Black Diamond Upland (**BLA**) ecodistrict. Parent materials, the prime parameter used in delineating ecosites, are coded as follows:

A Anthropogenic: Human-made or human-modified materials or features.

C Colluvium: Unconsolidated materials moved by gravity; often at the base of a slope. Slopewash deposits or veneers are included.

X (in association with C: "CX") Residuum: The product of *in situ* decomposition (e.g. weathering) of rock.

F Fluvial: Related to streamflow and its associated erosional / depositional processes and features.

FL Fluvio-Lacustrine: Lacustrine (or glaciolacustrine) deposits that have been partially re-worked by fluvial processes.

GF Glacio-Fluvial: Pertaining to meltwater streams from wasting glacier ice and especially to the deposits and landforms produced by the streams.

M Morainal (till): Loosely-consolidated rock debris formerly on or in a glacier, that accumulated in place as the surface ice was removed by ablation.

Numbers following the parent material identifier, such as 1,2,3, etc. represent specific combinations of landscape characteristics (slope steepness, drainage, soil subgroups, biota) occuring on the parent materials that more precisely describe the ecosite. Decimal numbers used in the Colluvial ecosite 2 show sub-categories primarily related to the composition and slope position of extensive and highly-varied Mixed Shrub communities in the Park.[10]

The slash ("/") marks used in the Vegetation Community descriptions separate vertical strata (e.g. canopy / shrubs / ground cover), and dashes ("-") are between dominant and sub-dominant (or in some cases co-dominant) species.

Slope classes, and soil subgroups and textures follow the Canadian System of Soil Classification. The seven soil drainage classes follow the CanSIS Manual for Describing Soils in the Field (Land Resource Research Institute 1983), and are reproduced in CAPAF (1994).

4.0 RESULTS

4.1 Ecological Land Classification

Map 4 shows a delineation of ecological units in Big Hill Springs Provincial Park distinguished primarily by geomorphic parameters (site, drainage, soils, etc.) and secondly by vegetation communities.

4.2 Vegetation Community Types

In most respects, the vegetative species and communities of the study area conform to those documented for the Foothills Parkland: *Agropyron* spp. (wheat grass) – *Poa* spp. (bluegrass) – *Danthonia parryi* (Parry's oat grass) communities dominate grasslands, with a large diversity of forb and grass species. *Populus tremuloides* (aspen) is generally dominant in the upland forests, with *Populus balsamifera* (balsam poplar) and *Picea glauca* (white spruce) occurring on shadier and/or moister sites. Distinctive in the area, willow groveland dominated by *Salix bebbiana* (Bebb's willow) (Achuff 1994) occurs in a variety of environments at Big Hill Springs ranging from medium-textured fluvial and fluvio-lacustrine material on imperfectly to poorly-drained sites as found in the coulee bottoms, to drier till-blanketed upland sites.

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[10] At this level of mapping, a *full* ecosite code would incorporate the Natural Subregion and ecodistrict identifiers (e.g. 14BLA.C2.1). An abbreviated version (e.g. C2.1) is shown on the ELC legend and map as all the ecosites here are in the same ecodistrict.

Field data from the 29 sites were classified into 25 different vegetation community types (4 sites were essentially duplicates), which can be grouped into generic categories of two forest types, two shrubland types, and three grassland types.

Vegetation community types are integral to the character of an ecosite. Although community types and landform units have typical associations, they, as with individual species, range from those occupying landscape-specific habitat to those common across a variety of environments. This is reflected in the Community Type descriptions that follow, and in a species-site list, Appendix 1.

The slash ("/") mark shown in the community type nomenclature separates vertical strata (e.g. canopy / shrubs / ground cover), and dashes ("-") are between dominant and sub-dominant (or in some cases co-dominant) species, by stratum. More typical conditions (e.g. in a range of slopes, moisture regimes, or set of soil subgroups) are named first in the community description tables. Proportions of a community's cover types can vary significantly between sites depending on local conditions.

Aspen Woodland

Three aspen community types were sampled in this study, representing the range that may be found mainly on the morainal uplands or colluvial coulee walls in the south part of the Park. Smaller and isolated stands were planted at the picnic sites, and can also be found on levees and banks along the lower reach of Big Hill Springs Creek. Shrubby understories, reflecting varying moisture and nutriest regimes, consist primarily of cow parsnip, prickly rose, with occasional snowberry.

4.2.1 Aspen / Cow parsnip

Below the Big Hill Springs coulee crest, in a mesic transition zone between the morainal aspen groves and the white spruce and balsam poplar-dominated units lower down, an aspen / cow parsnip community has established. About 5% white spruce are present in the overstory and understory, signifying the onset of a spruce-dominated climax community. Soil moisture may be retained (i.e. infiltration impeded) due to a shallow depth to bedrock.

Big Hill Springs Provincial Park Community Type: Aspen / Cow parsnip	
Sites: #23	Ecosites: C3

Moisture regime: mesic		Nutrient regime: permesotrophic	
Soil drainage: moderate		Soil subgroups: O.BL	
Slopes: 31-45%		Slope position, Aspect: Crest-Upper, NE	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Trees:	*Populus tremuloides* *Picea glauca*	aspen white spruce	30 5
Shrubs:	*Ribes oxyacanthoides*	northern gooseberry	5
Forbs:	*Heracleum lanatum* *Viola canadensis*	cow parsnip western Canada violet	70 15
Gram-inoids:	*Elymus innovatus* *Poa pratensis*	hairy wild rye Kentucky bluegrass	15 15

4.2.2 Aspen / Prickly rose

Mature to old seral stands of aspen occupy areas adjacent to the aspen / cow parsnip communities. They occur on better-drained soils along the south side of the Park in morainal and colluvial parent materials. No significant understory has developed, and a variety of shrubs, mainly prickly rose and scattered white spruce, dominate this stratum.

Big Hill Springs Provincial Park Community Type: Aspen / Prickly rose			
Sites: #6, 22		Ecosites: C3, M2	
Moisture regime: mesic		Nutrient regime: mesotrophic	
Soil drainage: moderate - well		Soil subgroups: CA.BL	
Slopes: 10-45%		Slope position, Aspect: Mid, NE	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Trees:	*Populus tremuloides*	aspen	45-60
Shrubs:	*Rosa acicularis* *Ribes oxyacanthoides* *Rubus idaeus* *Symphoricarpos albus*	prickly rose northern gooseberry wild red raspberry snowberry	20-35 5-10 5-10 3-8
Forbs:	*Viola canadensis* *Pyrola asarifolia*	western Canada violet common pink wintergreen	10-25 1-3

Gram-inoids:	*Elymus innovatus* *Poa pratensis*	hairy wild rye Kentucky bluegrass	1-15 5-10

4.2.3 Aspen / Snowberry-Prickly rose

Evidence of brush encroachment is found on grassy sites near the southwest edge of the Park above Big Hill Springs coulee. Here the aspen is open, short, and somewhat gnarly suggesting environmental stresses caused by insolation, moisture deficits, and competition with brush species. Other nearby aspen communities on till exhibit similar soil characteristics (horizons, thicknesses, textures) but here we have a typical grassland soil. Snowberry, an increaser, is most common in dry habitats, and its berries are toxic.

Big Hill Springs Provincial Park Community Type: Aspen / Snowberry – Prickly rose			
Sites: #20		Ecosites: M2	
Moisture regime: submesic		Nutrient regime: mesotrophic	
Soil drainage: moderate		Soil subgroups: CA.BL	
Slopes: 2-5%		Slope position, Aspect: Upper, SE	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Trees:	*Populus tremuloides*	aspen	20
Shrubs:	*Symphoricarpos albus* *Rosa acicularis* *Ribes oxyacanthoides*	snowberry prickly rose northern gooseberry	30 25 5
Forbs:	*Heracleum lanatum* *Thalictrum venulosum*	cow parsnip veiny meadow rue	2 2
Gram-inoids:	*Poa pratensis* *Elymus innovatus*	Kentucky bluegrass hairy wild rye	20 3

Balsam Poplar or Balsam Poplar – White Spruce Woodland

Balsam poplar is associated with typically moister habitats than is aspen, such as depressions and fluvial terraces and floodplains. In the study area, ideal environments are found along Big Hill Springs Creek and the north-facing coulee wall above it. White spruce often shares the habitat, tending in many sites to succeed balsam poplar with a shade-tolerant climax community. The 3 communities described below are at differing successional stages, evidenced by the proportions of balsam and spruce.

4.2.4 Balsam poplar / Cow parsnip

This community is found along the Big Hill Springs Creek floodplain and coulee floor, from the picnic site west to mid-ravine, where white spruce become mixed in progressively shadier sites. Much of the area has a hummocky or terraced microrelief (created by fluvial erosion and deposition over time) creating a myriad of moist depressions and drier knolls. The balsam poplar favour the comparatively dry sites here, growing to over 20m, and the cow parsnip tend to the depressions. The Chernozem soil near the mouth of the coulee suggests this area was once grassed, perhaps used as pasture, and encroached by balsam poplar with a change in land use. No significant spruce understory was found at the sample site, however a few young aspen were noted. The *Viola, Geranium*, and *Delphinium* are common to moist woods.

Big Hill Springs Provincial Park Community Type: Balsam poplar / Cow parsnip			
Sites: #24		Ecosites: F5	
Moisture regime: mesic		Nutrient regime: permesotrophic	
Soil drainage: well		Soil subgroups: O.BL	
Slopes: 2-5%		Slope position, Aspect: Depression, SE	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Trees:	*Populus balsamifera*	balsam poplar	35
Shrubs:	*Populus balsamifera* *Ribes oxyacanthoides*	balsam poplar northern gooseberry	5 5
Forbs:	*Heracleum lanatum* *Viola canadensis* *Delphinium glaucum* *Geranium richardsonii*	cow parsnip western Canada violet tall larkspur wild white geranium	15 8 5 5
Gram-inoids:	*Poa pratensis* *Bromus inermis*	Kentucky bluegrass awnless brome	10 8

4.2.5 Balsam poplar – White spruce / Willow / Horsetail

This mixedwood community is found associated with a variety of relatively mosit sites: (1) in the shady riparian zone on the coulee floor where overbank flooding of Big Hill Springs Creek and saturated soil is common, (2) sites further upstream and closer to the creek than the Balsam / Cow parsnip community described previously, and (3) north-

facing coulee banks in the northwest parcel. Spruce may be expected to replace the seral Balsam poplar in drier sites. Species data below are from Site #13; #19 is similar.

Big Hill Springs Provincial Park Community Type: Balsam poplar - White spruce / Willow / Horsetail			
Sites: #13,19		Ecosites: F5, C4	
Moisture regime: subhydric - mesic		Nutrient regime: permesotrophic	
Soil drainage: very poor - well		Soil subgroups: R.HG, CA.BL	
Slopes: 0-70%		Slope position, Aspect: Depression, lower-mid; N	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Trees:	*Populus balsamifera* *Picea glauca*	balsam poplar white spruce	10 10
Shrubs:	*Salix bebbiana* *Populus balsamifera* *Ribes oxyacanthoides*	beaked willow balsam poplar northern gooseberry	25 5 3
Forbs:	*Equisetum arvense* *Aster conspicuus* *Epilobium angustifolium* *Veronica americana*	common horsetail showy aster common fireweed American brooklime	20 5 3 2
Gram-inoids:	*Carex* spp. *Poa pratensis* *Catabrosa aquatica*	sedge Kentucky bluegrass brook grass	15 5 3

4.2.6 White Spruce – Balsam poplar / Hairy wild rye

This community type is found at mid- to lower-slopes of the north-facing wall of Big Hill Springs ravine. The proportion of white spruce in the community is greater to the west up the ravine, and up-slope. The balsam poplar component is typical of lower slopes, while aspen would be found instead on drier uplands. It exemplifies a mature climax forest community for the study area.

Big Hill Springs Provincial Park Community Type: White spruce – Balsam poplar / Hairy wild rye	
Sites: #7	Ecosites: C5

Moisture regime: submesic		Nutrient regime: mesotrophic	
Soil drainage: well		Soil subgroups: CA.BL, O.EB	
Slopes: 46-70%		Slope position, Aspect: Mid, NE	
Predominant / key species:			
Scientific name		Common Name	% Cover
Trees:	*Picea glauca* *Populus balsamifera* *Populus tremuloides*	white spruce balsam poplar aspen	35 10-15 * 10
Shrubs:	*Picea glauca* *Sheperdia canadensis* *Ribes oxyacanthoides* *Rosa acicularis* *Symphoricarpos albus* *Rubus idaeus*	white spruce buffalo berry northern gooseberry prickly rose snowberry wild red raspberry	3 7 7 6 5 5
Forbs:	*Aster conspicuus* *Viola canadensis*	showy aster western Canada violet	7 5
Gram-inoids:	*Elymus innovatus* *Poa pratensis*	hairy wild rye Kentucky bluegrass	25 10

* 10% denotes canopy; 15% denotes understory

Shrubland – Willow dominated

Willow (*Salix* spp.) occurs in a wide range of landscapes or ecological units such as woods, thickets, riverbanks, wetlands, and disturbed sites. They provide browse and bedding for herbivores. At Big Hill Springs, a recurring species is *Salix bebbiana* (beaked willow) encountered in wetland as well as upland sites, and in poor to rich nutrient regimes.[11] Willow is usually found here with secondary shrub species in areas once grassland and under a grazing regime, establishing first in drainages before spreading.

4.2.7 Willow – Cinquefoil / Bluegrass

This wetland community of 1-2m high willows straddles the lower reach of Big Hill Springs Creek in Big Hill coulee, between the road at the Park's north boundary and Big Hill Creek. It has formed on the outer fringe of the alluvial fan feature where creek water maintains a high soil moisture level. Aspens, some planted during landscaping, occupy

[11] At some sites, willow was recorded to the genus level only. Other willow species have been observed in the Park, mainly in wet areas: *S. pseudomonticola* (false mountain willow), *S. planifola* (flat-leaved willow), *S. lucida* (shining willow), *S. maccalliana* (velvet-fruited willow), and *S. lutea* (yellow willow) (AEP 1994).

drier knolls and levees on the upstream edge of the unit. Gleyed medium-textured soil, with a high carbonate content indicates moist and nutrient-rich conditions. The cinquefoil, about .5m in height, is most dense in openings between the willows and around the edge of the community.

Big Hill Springs Provincial Park Community Type: Willow – Cinquefoil / Bluegrass			
Sites: #2		Ecosites: F2	
Moisture regime: subhydric		Nutrient regime: eutrophic	
Soil drainage: imperfect		Soil subgroups: GLCU.HR	
Slopes: 0-.5%		Slope position, Aspect: Toe-Depression, N/A	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Salix bebbiana* *Potentilla fruticosa* *Ribes oxyacanthoides*	beaked willow shrubby cinquefoil northern gooseberry	30 20 15
Forbs:	*Achillea millefolium* *Mentha arvensis* *Geum aleppicum* *Senecio* sp.	common yarrow wild mint yellow avens groundsel	5 5 3 3
Gram-inoids:	*Poa pratensis* *Juncus balticus* *Poa palustrus*	Kentucky bluegrass wire rush fowl bluegrass	40 20 10

4.2.8 Willow / Bluegrass – Rough fescue

This seral upland community is found on inclined to undulating till mantle above Big Hill Springs coulee to the south. The sample site, at the southwest corner in the northwest parcel of the Park, is affected by cattle grazing and brush encroachment. This vegetation association is a variant of other upland willow-dominated communities (like 4.2.9) along the southwest edge of the Park, and extending southward. Fescue is a decreaser under grazing and may be replaced by the more invasive bluegrass, especially on abused upland sites (Tannas 1997).

Big Hill Springs Provincial Park Community Type: Willow / Bluegrass – Rough fescue	
Sites: #18	Ecosites: M1
Moisture regime: mesic	Nutrient regime: permesotrophic
Soil drainage: moderate	Soil subgroups: O.BL
Slopes:10-30%	Slope position, Aspect: Mid, NE
Predominant / key species:	

Scientific name		Common Name	% Cover
Shrubs:	*Salix bebbiana* *Sheperdia canadensis* *Potentilla fruticosa* *Betula glandulosa* *Populus balsamifera*	beaked willow Canada buffalo berry shrubby cinquefoil bog birch balsam poplar	30 10 5 5 5
Forbs:	*Fragaria virginiana*	wild strawberry	8
Gram-inoids:	*Festuca scabrella* *Poa pratensis* *Danthonia parryi*	rough fescue Kentucky bluegrass Parry oat grass	15 15 5

4.2.9 Willow - Prickly rose / Hairy wild rye - Bluegrass

Beyond the aspen communities above Big Hill Springs coulee, willow-dominated groves spread up-slope to the south, just beyond the Park's irregular southwest boundary on undulating and gullied morainal uplands. Fingers of this community protrude into the Park through breaks between the aspen stands. Scattered white spruce are found on knolls and rises between gullies. The dominant shrub species found in the community favour relatively rich nutrient regimes as are found in calcareous Black Chernozems present here. Aspen could encroach in some sites of this community to form climatic climax stands, however succession would be slow in many parts due to dry conditions, and the willow would remain an edaphic climax.

Big Hill Springs Provincial Park Community Type: Willow - Prickly rose / Hairy wild rye - Bluegrass			
Sites: #21		Ecosites: M1	
Moisture regime: submesic		Nutrient regime: permesotrophic	
Soil drainage: moderate		Soil subgroups: CA.BL	
Slopes:10-30%		Slope position, Aspect: Mid, NE	
Predominant / key species:			
Scientific name		Common Name	% Cover
Shrubs:	*Salix bebbiana* *Rosa acicularis* *Symphoricarpos albus* *Amelanchier alnifolia*	beaked willow prickly rose snowberry saskatoon	45 * 40 20 5
Forbs:	*Rubus idaeus* *Taraxacum officinale*	wild red raspberry common dandelion	5 5
Gram-inoids:	*Elymus innovatus* *Poa pratensis*	hairy wild rye Kentucky bluegrass	25 20

* Willow occupies the "tall shrub" stratum, while the others occupy the "low shrub".

Mixed Shrublands

Communities that fall into this category are as diverse as they are extensive at Big Hill Springs. Sites sampled were found to be dominated mainly by snowberry (buckbrush) or silver berry (wolf-willow) and to a lesser extent by prickly rose. Significantly, they occur mainly on hillsides within and near the Park perhaps due to lighter historical grazing regimes and/or sufficient moisture on the mid-to-lower slopes.

4.2.10 Snowberry – Prickly rose / Bluegrass

This community is found on a relatively moist lower hillslope of Big Hill coulee south the mouth of Big Hill Springs ravine (upslope from the parking lot). Shallow depth to bedrock and the lower slope position produce seeps that support lush growth at certain microsites.[12] While sparse, the moisture and nutrient-loving Cow parsnip was encountered on lower slopes. Scattered 1-2m willow sit over this knee-high shrub community giving it an open appearance on the hillside. Aspen are beginning to encroach this seral community from the fringes at many sites. The snowberry and rose are increasers; saskatoon is a decreaser, but a valuable component of native range (Tannas 1997).

Big Hill Springs Provincial Park Community Type: Snowberry - Prickly rose / Bluegrass			
Sites: #5		Ecosites: C2.1	
Moisture regime: subhygric		Nutrient regime: permesotrophic	
Soil drainage: moderate		Soil subgroups: O.BL	
Slopes: 31-45%		Slope position, Aspect: Lower, E	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Trees:			
Shrubs:	*Symphoricarpos albus* *Rosa acicularis* *Amelanchier alnifolia* *Salix bebbiana* *Ribes oxyacanthoides*	snowberry prickly rose saskatoon beaked willow northern gooseberry	25 30 15 5 4
Forbs:	*Thalictrum venulosum* *Anemone canadensis*	veiny meadow rue Canada anemone	4 3
Gram-inoids:	*Poa pratensis* *Bromus inermis*	Kentucky bluegrass awnless brome	35 5

[12] This is approximately where ANHIC records indicate an observation of the relatively rare – and tracked - fern species *Pellaea glabella* (smooth cliff brake) in 1994. Its preference for habitat among limestone rocks (Moss 1992) would be met by the local tufa deposits.

4.2.11 Snowberry / Brome - Bluegrass

On the floor of Big Hill Springs ravine, the open and gently-sloping area supporting this community appears to have been an old clearing, perhaps pasture, now undergoing significant brush encroachment both from the creekbanks below and the aspen above. The sample site is on one of several fluvial terraces in a sequence extending the length of the coulee. Nutrient-rich, moist, with a deep alluvial topsoil, it provides ideal habitat for the invasive brome grass.

Big Hill Springs Provincial Park Community Type: Snowberry / Brome - Bluegrass			
Sites: #14		Ecosites: F6	
Moisture regime: subhygric		Nutrient regime: eutrophic	
Soil drainage: well		Soil subgroups: R.BL	
Slopes: 6-15%		Slope position, Aspect: Toe, E	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Symphoricarpos albus* *Salix bebbiana* *Ribes oxyacanthoides*	snowberry beaked willow northern gooseberry	15 5 2
Forbs:	*Heracleum lanatum* *Taraxacum officanale* *Urtica dioica*	cow parsnip common dandelion common nettle	5 5 3
Gram-inoids:	*Bromus inermis* *Poa pratensis* *Carex sprengelii*	awnless brome * Kentucky bluegrass Sprengell's sedge	50 15 5

* Colloquially called "smooth" brome.

4.2.12 Snowberry / Bluegrass

This community is found on open lower slopes of both coulees in relatively arid environments (due to insolation, slope, and well-drained soil) on colluvial parent materials. The wide ratio range of snowberry to bluegrass in these sites (i.e. 15:80 to 75:10) suggests the effects of local site characteristics (e.g. seeps, aspect, microrelief, grazing regime) on competition between these two increaser species. The Dark Brown Chernozem was found on a predominantly shrubby site with a strong south aspect.

Big Hill Springs Provincial Park Community Type: Snowberry / Bluegrass	
Sites: #25,29	Ecosites: C2.1

Moisture regime: submesic		Nutrient regime: mesotrophic	
Soil drainage: well		Soil subgroups: CA.BL, CA.DB	
Slopes: 16-30%		Slope position, Aspect: Lower, S-W	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Symphoricarpos albus* *Ribes oxyacanthoides* *Amelanchier alnifolia*	snowberry northern gooseberry saskatoon	15-75 0-3 0-3
Forbs:	*Geranium viscosissimum*	sticky purple geranium	1-5
Gram-inoids:	*Poa pratensis*	Kentucky bluegrass	10-80

4.2.13 Silverberry – Choke cherry / Bluegrass

Dense groves of silverberry are found on the lower colluvium-blanketed slopes of the east wall of Big Hill Creek coulee along the Park's east boundary, and in a few sites on the south-facing bank of Big Hill Springs ravine. These sites represent typical silverberry habitat. It's an increaser, resistant to moderate browsing and forms rather extensive colonies as climax grasses decline. Choke cherry is a decreaser, not as highly competetive (Tannas 1997). This indicates a silverberry / bluegrass edaphic climax community.

Big Hill Springs Provincial Park Community Type: Silverberry – Choke cherry / Bluegrass			
Sites: #9		Ecosites: C2.2	
Moisture regime: submesic		Nutrient regime: mesotrophic	
Soil drainage: moderate		Soil subgroups: O.R	
Slopes: 31-70%		Slope position, Aspect: Mid-Lower, W-S	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Eleagnus commutata* *Prunus virginiana* *Symphoricarpos albus* *Amelanchier alnifolia*	silverberry choke cherry snowberry saskatoon	60 * 30 25 5

Forbs:	*Aster conspicuus* *Thalictrum venulosum*	showy aster veiny meadow rue	5 4
Gram-inoids:	*Poa pratensis* *Agropyron dasystachyum*	Kentucky bluegrass northern wheatgrass	20 5

* Silverberry occupies the "tall shrub" stratum, while the others occupy the "low shrub".

4.2.14 Prickly rose - Silverberry / Bluegrass

This community occupies the middle hillside zone between the road and the colluvium-resuduum-outcrops unit (CX1) on the west crest of Big Hill Creek coulee. Buffalo berry is present at the upper fringes. There are signs of soil creep along this bank, perhaps exacerbated by cattle grazing-trampling over time, however it currently appears stable due to vegetative cover. The shrubs, all increasers, comprise a maturing edaphic climax community due to lack of moisture (caused by strong slopes, well-drained soil, and insolation) and poor soil development.

Big Hill Springs Provincial Park Community Type: Silverberry – Choke cherry / Bluegrass			
Sites: #28		Ecosites: C2.3	
Moisture regime: submesic		Nutrient regime: permesotrophic	
Soil drainage: well		Soil subgroups: CA.BL	
Slopes: 31-45%		Slope position, Aspect: Mid, E	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Rosa acicularis* *Eleagnus commutata* *Symphoricarpos albus*	prickly rose silverberry snowberry	40 25 5
Forbs:	*Apocynum androsaemifolium* *Geranium viscosissimum*	spreading dogbane sticky purple geranium	3 3
Gram-inoids:	*Poa pratensis*	Kentucky bluegrass	10

4.2.15 Silverberry - Cinquefoil / Wheat grass - Sedge

This community is described using a composite of characteristics of two similar and nearby sites on the upper slopes on the east wall of Big Hill Springs coulee (above and just beyond the Park's east boundary). These sites are just below the glaciofluvial terrace

(described in Section 2.6) on colluvial veneer over inclined weathered bedrock. The sedge, a drought-resistant increaser, sometimes found on such exposed areas and eroded slopes at high elevations, can be very effective in erosion control here due to its dense and tough root structure (Tannas 1997). Of the grasses - all increasers - June grass is native and a common grassland species. The sample sites are classed as young to mature edaphic climax communities.

Big Hill Springs Provincial Park Community Type: Silverberry – Cinquefoil / Wheat grass - Sedge			
Sites: #8,10		Ecosites: C2.2	
Moisture regime: submesic		Nutrient regime: mesotrophic	
Soil drainage: moderate		Soil subgroups: O.R, R.DB	
Slopes: 31-70%		Slope position, Aspect: Mid-Lower, W-S	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Eleagnus commutata* *Amelanchier alnifolia* *Potentilla fruticosa* *Prunus virginiana*	silverberry saskatoon shrubby cinquefoil choke cherry	8-15 5-15 2-5 1
Forbs:	*Galium boreale* *Artemesia frigida*	northern bedstraw pasture sagewort	3-30 3-10
Gram-inoids:	*Agropyron dasystachyum* *Poa pratensis* *Carex filifolia* *Koeleria macrantha*	northern wheat grass Kentucky bluegrass thread-leaved sedge June grass	10-30 20 15-20 5-25

Grasslands

The four grassland communities described below represent a cross-section of essentially what remains of "native" or natural communities (opposed to tame or reclaimed sites) in an area long used for ranching. The presence and occasional dominance of introduced or non-native species like crested wheat grass and Kentucky bluegrass attest to the long-term effects of historical pasture seeding, dispersion by wind and animals, grazing regimes, and aggressive habitat competition by introduced / invader and increaser species such as brome. AEP (1997) describes that fescue grasslands, including those in the Parkland, are threatened by extensive cultivation and that any remaining areas should be considered endangered.

Grassland community types at Big Hill Springs are often quite variable by species composition, and spatially - as influenced by site-specific conditions including parent material, slope-aspect, microrelief, moisture, and land use.

4.2.16 Sand grass – Northern wheat grass – June grass

The sampled site is on an open mid-slope of the north bank of Big Hill Springs coulee, on medium to coarse soils. These factors combined with a strong south aspect contribute to the relative aridity of the site, hence its edaphic climax successional status. Although an increaser, sand grass is susceptible to trampling, with implications for human and cattle access and the site's slope stability. Northern wheatgrass, normally an increaser – and tolerant to grazing and trampling – may be a decreaser on such dry sites. June grass, often indicative of overgrazing, is an increaser (Tannas 1997).

Big Hill Springs Provincial Park Community Type: Sand grass – Northern wheat grass – June grass			
Sites: #26		Ecosites: C1	
Moisture regime: submesic-subxeric		Nutrient regime: mesotrophic	
Soil drainage: well-rapid		Soil subgroups: O.R	
Slopes: 46-70%		Slope position, Aspect: Mid, S	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Potentilla fruticosa*	shrubby cinquefoil	1
Forbs:	*Artemesia frigida* *Trifolium repens* *Phlox hoodii*	pasture sagewort white clover moss phlox	2 2 2
Gram-inoids:	*Calamovilfa longifolia* *Agropyron dasystachyum* *Koeleria macrantha* *Carex filifolia*	sand grass northern wheatgrass June grass thread-leaved sedge	30 15 15 5

4.2.17 Northern wheat grass – Bluebunch fescue

This community shares the same ecological unit as the previous one, about 60m to the east along the north bank of Big Hill Springs coulee. Significant differences between sites are the shallower slope and finer-textured soil here facilitating Chernozemic soil development. Both the predominant grass species are increasers and can withstand grazing and trampling. The scattered shrubby cinquefoil on site may be seen as invasive and troublesome in range-lands, although they contribute to erosion control. This was the only sample site where the northern green bog-orchid (*Habenaria hyperborea*) was encountered – unusual in a dry grassland habitat, and uncommon in the Park (AEP 1994).

Big Hill Springs Provincial Park Community Type: Northern wheat grass – Bluebunch fescue	
Sites: #27	Ecosites: C1

Moisture regime: submesic-mesic		Nutrient regime: permesotrophic	
Soil drainage: well		Soil subgroups: CA.BL	
Slopes: 10-15%		Slope position, Aspect: Mid, S	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Potentilla fruticosa*	shrubby cinquefoil	1
Forbs:	*Thermopsis rhombofolia* *Smilacina stellata* *Solidago missouriensis*	golden bean star-flowered Solomon's seal low goldenrod	5 5 3
Gram-inoids:	*Agropyron dasystachyum* *Festuca idahoensis* *Koeleria macrantha* *Poa pratensis* *Stipa comata*	northern wheat grass bluebunch fescue June grass Kentucky bluegrass needle-and-thread	30 20 5 5 5

4.2.18 Parry oat grass – Kentucky bluegrass

At the far northwest corner of the main Park parcel, the grassy landscape grades from a gently-undulating glaciofluvial terrace to upper colluvial slopes of Big Hill Springs coulee. The Chernozemic Black topsoil is deeper and fragment-free on the benchland portion. Light grazing use is evident. Both dominant grasses are increasers, although bluegrass is probably the more invasive and persistent, often replacing native species on abused upland sites in the region (Tannas 1997). Similarly, shrubby cinquefoil is invasive, adapted to a variety of soils, and can degrade good-quality grasslands. Successional status is a mature edaphic climax.

Big Hill Springs Provincial Park Community Type: Parry oat grass – Kentucky bluegrass			
Sites: #12		Ecosites: GF1, C1	
Moisture regime: mesic-submesic		Nutrient regime: mesotrophic	
Soil drainage: moderate		Soil subgroups: CA.BL	
Slopes: .5-30%		Slope position, Aspect: Crest-Upper, S	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Potentilla fruticosa* *Rosa acicularis*	shrubby cinquefoil prickly rose	2 1
Forbs:	*Thalictrum venulosum* *Sisyrinchium montanum* *Anemone patens*	veiny meadow rue common blue-eyed grass prairie crocus	8 3 2

Gram-inoids:	*Danthonia parryi* *Poa pratensis* *Koeleria macrantha* *Stipa virdula*	Parry oat grass Kentucky bluegrass June grass green needle grass	25 25 5 5

4.2.19 Kentucky bluegrass – Rough fescue

The sample site is located in the northwest parcel of the Park, low on the glaciofluvial terrace on the north side of the upper Big Hill Springs coulee. The soil is medium-textured Black Chernozemic. The site, long a pasture, apparently remains under a light grazing regime. Bluegrass is an increaser, often replacing natives on abused upland sites. Fescues are usually hardy, drought-resistant and suited to intensive grazing. Rough fescue is a valuable climax species, but slow to establish and is often a decreaser in many places (Tannas 1997). There is a rich variety of forbs represented in this mature edaphic climax community, although in small proportions.

Big Hill Springs Provincial Park Community Type: Kentucky bluegrass – Rough fescue			
Sites: #16		Ecosites: GF1	
Moisture regime: subxeric		Nutrient regime: mesotrophic	
Soil drainage: well		Soil subgroups: O.BL	
Slopes: 0-9%		Slope position, Aspect: Upper-Mid, S	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Forbs:	*Thermopsis rhombofolia* *Artemesia frigida* *Achillea millefolium*	golden bean pasture sagewort common yarrow	5 5 2
Gram-inoids:	*Poa pratensis* *Festuca scabrella* *Agropyron dasystachyum* *Koeleria macrantha* *Stipa virdula*	Kentucky bluegrass rough fescue northern wheatgrass June grass green needle grass	50 25 5 2 3

Modified Grasslands

Some sites in the Park, as discussed in previous sections, have experienced cultivation: seeding and / or reclamation and the introduction of non-native grass species. These correspond to former tame pastures recently acquired by the Park (i.e. the northwest parcel), and reclaimed facility sites in the lower part of the Park.

4.2.20 Northern wheat grass – June grass

This community was identified on the edge of the former Park headquarters facility site. Located on an elevated fluvial terrace in Big Hill Creek ravine, much of the central part was altered by the processes of site preparation, construction, landscaping, and finally, dismantling and reclamation. The peripheral vegetation appears essentially native and is synopsized in the table below.

The reclaimed portion has a heavy cover of brome grass (*Bromus* spp.) - invasive, but excellent for site stabilization (Tannas 1997), with a lesser amount of Kentucky bluegrass.[13] There are remnant ornamental shrubs: mainly caragana, with some lilac and honeysuckle. Perhaps due to contouring and tillage at reclamation, as well its receiving slope position, this site is quite moist as evidenced by gleyed soil, lush brome growth, and balsam poplar shoots.

Big Hill Springs Provincial Park Community Type: Northern wheat grass – June grass			
Sites: #11		Ecosites: F6	
Moisture regime: subhygric		Nutrient regime: permesotrophic	
Soil drainage: imperfect		Soil subgroups: O.BL, O.HG	
Slopes: .5-2.5%		Slope position, Aspect: Toe-Depression, N/A	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Potentilla fruticosa* *Juniperus horizontalis*	shrubby cinquefoil creeping juniper	2 2
Forbs:	*Thermopsis rhombofolia* *Artemesia frigida* *Galium boreale*	golden bean pasture sagewort northern bedstraw	3 5 20
Gram-inoids:	*Agropyron dasystachyum* *Poa pratensis* *Koeleria macrantha* *Danthonia parryi*	northern wheatgrass Kentucky bluegrass June grass Parry oat grass	25 15 15 5

4.2.21 Awnless brome – Timothy

On an ecosite resembling the previous one, this grassland community is situated on the alluvial fan near the mouth of Big Hill Springs Creek where the old campground was. Lin (1980) describes the area as being covered with exotic grasses and weeds before reclaiming with a seed mix of crested wheat grass, Kentucky bluegrass, creeping red

[13] Lin (1980) documents that the site was reclaimed with a seed mix of 30% creeping red fescue (*Festuca* sp.), 45% crested wheat grass (*Agropyron pectiniforme*), and 5% white clover (*Trifolium repens*). This composition is not evident today.

fescue and white clover (as well as with some transplanted aspen and spruce). Since then, brome and timothy have invaded and dominated due to the moist and rich soils. The site is criss-crossed with old vehicle trails and tracks.

Big Hill Springs Provincial Park Community Type: Awnless brome - Timothy			
Sites: #4		Ecosites: F4	
Moisture regime: subhygric		Nutrient regime: permesotrophic	
Soil drainage: well		Soil subgroups: CA.BL	
Slopes: 2-5%		Slope position, Aspect: Toe-Depression, E	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Forbs:	*Ranunculus acris* *Trifolium pratense*	tall buttercup red clover	2 2
Gram-inoids:	*Bromus inermis* *Phleum pratense* *Carex* spp.	awnless brome * timothy sedge	60 30 5

* Colloquially called "smooth" brome.

4.2.22 Kentucky bluegrass - Awnless brome - Timothy

This community is found in a tame pasture near the centre of the northwest parcel, on the broad glaciofluvial terrace. Each grass species here is an increaser, with brome and timothy the more invasive, aggressive and persistent - and relatively more abundant in the moist depressions (shallow relict channels) at this site.

Big Hill Springs Provincial Park Community Type: Kentucky bluegrass – Awnless brome - Timothy			
Sites: #15		Ecosites: GF1	
Moisture regime: subhygric		Nutrient regime: mesotrophic	
Soil drainage: moderate		Soil subgroups: O.BL	
Slopes: 2-5%		Slope position, Aspect: Mid, SE	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Rosa acicularis*	prickly rose	1
Forbs:	*Thermopsis rhombofolia* *Artemesia ludoviciana* *Geranium viscosissimum*	golden bean prairie sagewort sticky purple geranium	5 3 3

Gram-inoids:	*Poa pratensis* *Bromus inermis* *Phleum pratense*	Kentucky bluegrass awnless brome timothy	80 5 5

Grasslands -Wet meadows

This category of vegetation community at Big Hill Springs is characterized by a site's proximity to water and high water table, and by a preponderance of hygrophytic graminoids such as sedges (*Carex* spp.) and rushes (*Juncus* spp.).

4.2.23 Tall buttercup / Wire rush

Above Big Hill Creek on the outer fringe of the alluvial fan, this meadow community has experienced cattle grazing (a tussocky surface) as well as effects from park visitors over time (since it surrounds the former campground). The soil, moist – as manifested by gleying in the profile, and rich in nutrients (calcareous) supports a lush vegetative cover. The introduced and invasive buttercup is common in such depressional and low meadows; and the rush, also an increaser is resistant to to trampling and spreads when other species decline (Tannas 1997).

Big Hill Springs Provincial Park Community Type: Tall buttercup / Wire rush			
Sites: #3		Ecosites: F3	
Moisture regime: subhygric		Nutrient regime: permesotrophic	
Soil drainage: imperfect		Soil subgroups: GLCU.R	
Slopes: 2-5%		Slope position, Aspect: Toe-Depression, E	
Predominant / key species:			
	Scientific name	Common Name	% Cover
Shrubs:	*Potentilla fruticosa*	shrubby cinquefoil	2
Forbs:	*Ranunculus acris* *Potentilla anserina* *Achillea millefolium*	tall buttercup silverweed common yarrow	15 5 4
Gram-inoids:	*Juncus balticus* *Phleum pratense* *Poa pratensis*	wire rush timothy Kentucky bluegrass	25 20 15

4.2.24 Water sedge

This riparian community is established on the floodplain of Big Hill Creek south of the confluence with Big Hill Springs Creek. Its thick rich, silty topsoil is subjected to periodic flooding and deposition. Trampling by cattle has degraded the soft creekbank with the formation of tussocks and small pits. Scattered willow in clumps and thickets surround the site upslope on the moister fringes of the alluvial fan. The sedge, normally a decreaser and somewhat susceptible to grazing pressure, can be good for soil-binding and erosion control in wet sites.

Big Hill Springs Provincial Park Community Type: Water sedge			
Sites: #1		Ecosites: F1	
Moisture regime: subhydric		Nutrient regime: eutrophic	
Soil drainage: imperfect - well		Soil subgroups: O.HR	
Slopes: 0-2.5 %		Slope position, Aspect: Depression-level, N/A	
Predominant / key species:			
Scientific name		Common Name	% Cover
Shrubs:	*Salix* spp.	willow	1
Forbs:	*Mentha arvensis* *Potentilla anserina*	wild mint silverweed	5 3
Gram-inoids:	*Carex aquatilus* *Poa pratensis*	water sedge Kentucky bluegrass	40 10

4.2.25 Kentucky bluegrass - Fowl bluegrass – Bebb's sedge

This edaphic climax community occurs adjacent to the uppermost spring discharge site on the floor of Big Hill Springs coulee, in the northwest parcel. Nominally tame pasture (as is the area just above it to the north), the site is significantly affected by year-round springwater, as well as by concentrated surface runoff in the spring and during rainy periods. Fowl bluegrass, unlike Kentucky bluegrass, is a decreaser and wetland species (Tannas 1997). This was the only site where the northern willow-herb (*Epilobium ciliatum*), generally common especially in wet and "springy places", was encountered.

Big Hill Springs Provincial Park Community Type: Kentucky bluegrass – Fowl bluegrass – Bebb's sedge	
Sites: #17	Ecosites: F5

Moisture regime: subhygric		Nutrient regime: permesotrophic	
Soil drainage: well		Soil subgroups: O.HR	
Slopes: 2-5%		Slope position, Aspect: Depression, NW	
Predominant / key species:			
Scientific name		Common Name	% Cover
Shrubs:	*Salix* spp.	willow	5
Forbs:	*Epilobium ciliatum* *Veronica americana*	northern willow-herb American brooklime	10 5
Gram-inoids:	*Poa pratensis* *Poa palustrus* *Phleum pratense* *Carex bebbii* *Catabrosa aquatica*	Kentucky bluegrass fowl bluegrass timothy Bebb's sedge brook grass	25 10 5 5 5

4.3 Significant Plant Species

Of the 126 vascular plant species encountered during this study, no rare or uncommon species (as tracked by ANHIC)[14] were observed. Six species deemed Uncommon by AEP (1994) were observed, and are indicated in the Vegetation Species List, Appendix 1.[15]

The ANHIC database contains a number of observations of 2 rare species in or close to Big Hill Springs Provincial Park.

Pellaea glabella	smooth cliff brake (fern)
Ranunculus aquatilus	large-leaved white water crowfoot

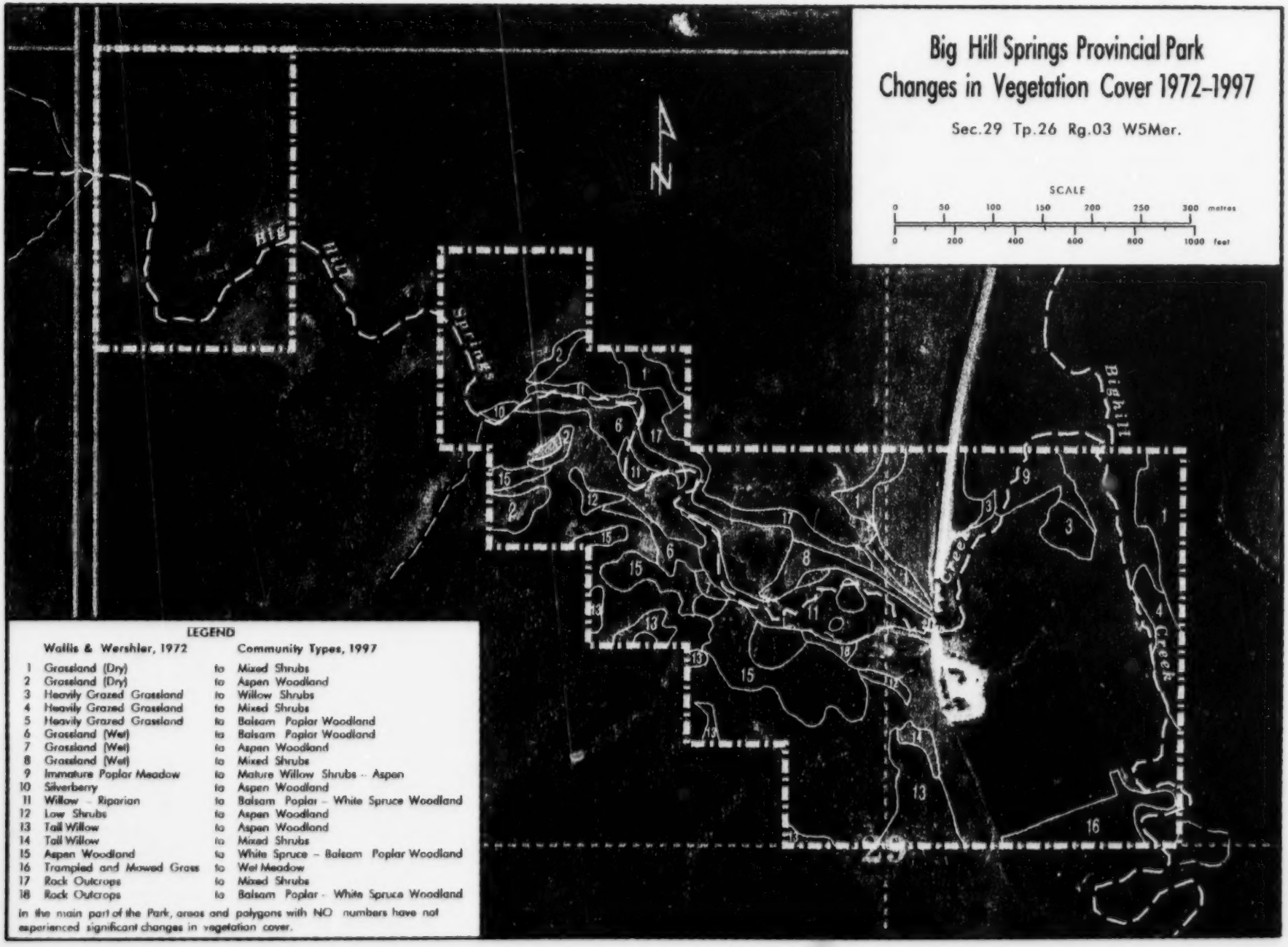
4.4 Significant Vegetation Cover Changes

Changes in vegetative cover represent the most apparent, extensive, and rapid of biophysical changes in the Park.

A natural process of vegetation succession in a conservation area such as a park would normally be viewed as positive, and management practices would seek to foster this ecological evolution. Succession from the region's historical extensive grass cover to parkland in the absence of extensive grazing (and *with* fire suppression) is almost

[14] Alberta Natural Heritage Information Centre database on rare plants. Administered by Alberta Environmental Protection, Natural Resources Service – Parks.

[15] Wallis and Wershler recorded 5 of these 6 species too. It may suggest they aren't that "uncommon".


Big Hill Springs Provincial Park
Changes in Vegetation Cover 1972–1997
Sec.29 Tp.26 Rg.03 W5Mer.
SCALE
0 50 100 150 200 250 300 metres
0 200 400 600 800 1000 feet
N
Big Hill
Springs
Big Hill Creek
29
LEGEND
Wallis & Wershler, 1972 — Community Types, 1997
1 Grassland (Dry) to Mixed Shrubs
2 Grassland (Dry) to Aspen Woodland
3 Heavily Grazed Grassland to Willow Shrubs
4 Heavily Grazed Grassland to Mixed Shrubs
5 Heavily Grazed Grassland to Balsam Poplar Woodland
6 Grassland (Wet) to Balsam Poplar Woodland
7 Grassland (Wet) to Aspen Woodland
8 Grassland (Wet) to Mixed Shrubs
9 Immature Poplar Meadow to Mature Willow Shrubs - Aspen
10 Silverberry to Aspen Woodland
11 Willow - Riparian to Balsam Poplar - White Spruce Woodland
12 Low Shrubs to Aspen Woodland
13 Tall Willow to Aspen Woodland
14 Tall Willow to Mixed Shrubs
15 Aspen Woodland to White Spruce - Balsam Poplar Woodland
16 Trampled and Mowed Grass to Wet Meadow
17 Rock Outcrops to Mixed Shrubs
18 Rock Outcrops to Balsam Poplar - White Spruce Woodland
In the main part of the Park, areas and polygons with NO numbers have not experienced significant changes in vegetation cover.

MAP 3

inevitable. As succession proceeds, community structure becomes more stratified, biomass and organic matter accumulate, and nutrient cycling becomes more internal in the system. Food webs become more complex, species diversity increases to a point and net community production approaches equilibrium (Smith 1996).

The transition of vegetative cover from pioneer and seral communities such as grasses, shrubs and poplar to maturing climax communities like spruce stands is evident in many areas of the Park. Expansion of the spruce and poplar communities into old shrubland in the south of the Park and in Big Hill Springs ravine is the most significant in an areal sense. In Big Hill coulee, willow and mixed-shrub groves have matured and spread into former grassland pasture.

Apparent changes between current vegetation community distribution and that mapped by Wallis and Wershler 25 years ago (possibly using June, 1970 airphoto data) are indicated on Map 3. However, differences in approaches to ground cover characterization, classification, and mapping - rather than real change - may bear on the validity or extent of some of the "Changes" shown on Map 3 (e.g. 16, 17, 18). These differences would preclude a detailed comparison and analysis.

5.0 ISSUES AND RECOMMENDATIONS

The following are considered to be some issues that bear on the Park's ecological integrity, conservation of its natural history features, and enjoyment by the public. Most are self-evident and may merit further detailed study in order to develop suitable management approaches.

5.1 Land Use

As long as grazing is approved for certain Park lands, degradation, or at least suspension of some natural processes (e.g. vegetation succession, streamcourse development) may be expected. A *range*-specific inventory and assessment should be performed if cattle grazing is likely to continue within the Park, so ecologically-based guidelines can be established.

Impacts from visitor use, as well, were apparent at some sites and might be mitigated by facility / infrastructure enhancements, and signage appealing to a conservation ethic.

5.2 Fences and Boundaries

Wire fences were established in a pre- or early Park setting to control cattle grazing. Some fences in and around the Park appear to have become obsolete for that purpose, yet remain in-situ, in varying states of repair and decay. As well, most fencelines have little

correspondence with Park boundaries. Evidence of the Park's true boundaries on the ground is very limited and (with the fencing and unofficial warning signs) may unnecessarily deter visitors from experiencing its far corners.

5.3 Sensitive Sites

No ecosites or vegetation communities in the Park were analysed specifically as to their biological / ecological or physical vulnerability. Komex (1998) comments on the susceptibility of the tufa formations to erosion and wear, and on the effects of cattle and streambank trampling on water quality. If there are any significantly sensitive sites at Big Hill Springs, most will likely be in the relatively soft streamcourse, riparian, or wet areas.

5.4 Bank Stability

The steeper coulee walls are weak and physically sensitive to weathering, erosion, and trampling; therefore susceptible to mass movements including outright collapse. Numerous creep, slump, and rockfall deposits were observed. Access to the top and bottom of these sites should be restricted.

5.5 Rare Plants

It was suggested (pers. comm., Joyce Gould – Keith Ainsley) during the course of fieldwork, that the best prospects of finding any rare or uncommon plant species, probably **mosses**, would be in the ecologically unique spring or stream sites, and by a bryophyte specialist. As well, locations of the two rare plants already identified in the Park should be sought-out. A follow-up rare plant survey may be warranted.

5.5 Brush Encroachment

Brush encroachment involves *viable* rangelands being invaded by woody vegetation - brush and young trees, to a point where forage production is lost or unavailable for grazing. It's evident from comparing historical and contemporary airphotos and maps that this is occurring at many sites in the Park, particularly above the south bank of Big Hill Springs coulee, and in Big Hill coulee. Assessments should be made with a view to to preserving grassland communities through pro-active measures, or to "let Nature take its course".

5.6 Adjacent Lands

It's apparent that with the two parcels of the Park not contiguous, and that because some of the Park's natural history features are minimally or not wholly enclosed by Park boundaries, that full and effective management of these features is constrained. Section 2.7 describes the link the Park plays in a regional green space network.

Big Hill Springs Provincial Park is a very small "island" - only 38 hectares, hardly ecologically viable on its own. It's vulnerable, and perhaps irreversibly affected by land use practices and industrial activities on nearby properties: farms, ranches, acreages, gravel operations, etc. Much of the local watershed drains through the Park, with implications for water quality and supply.

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Appendix 1

BIG HILL SPRINGS PROVINCIAL PARK: VEGETATION SPECIES

The 126 species listed below were observed and recorded during field sampling in July 1997. This list does not constitute a complete or exhaustive list of species to be found in the Park, but would supplement other inventories.

Habitat Codes: A - Aspen Woodlands; G – Grasslands; Gm – Modified Grasslands; M – Moist Meadows; P – Balsam poplar or Balsam poplar–White spruce dominated Woodlands; R – Riparian areas; Sm – Mixed Shrublands; Sw – Willow-dominated Shrublands.
The habitat code *sequence* shown below for each species is not significant. U – Uncommon (AEP 1994).

Species	Common Name	Habitat	Site #
Achillea millefolium	common yarrow	M / Sm / Sw / G / Gm / A	2,3,5,9,11,15,16,17,18,20,21,25,28
Actaea rubra	red and white baneberry	A	6,22,23
Agropyron dasystachyum	northern wheatgrass	Sm /G	8,9,10,11,16,26,27,29
Allium textile	prairie onion	Sm / G	10,11,26,27,29
Amelanchier alnifolia	saskatoon	Sm / A / Sw	5,8,9,10,18,20,22,28,29
Anemone canadensis	Canada anemone	M / Sm / A	2,3,5,6,14
Anemone multifida	cut-leafed anenome	Sm / G	8,11,16
Anemone patens	prairie crocus	G / Gm	12,15,27
Antennaria parvifolia	small-leaved everlasting	G	11,27
Apocynum androsaemifolium	spreading dogbane	Sm	8,9,10,28
Arctostaphlos uva-ursi	common bearberry	Sw	18
Artemesia frigida	pasture sagewort	Sm / G	8,9,10,11,16,25,26,27,28
Artemesia ludoviciana	prairie sagewort	Sm / Gm	5,9,15,29
Aster alpinus	alpine aster	Sm	25
Aster ciliolatus	Lindley's aster	A / P / Sm / Sw / G	6,7,9,12,18,21,23,24
Aster conspicuus	showy aster	A / P / Sm / Sw	6,7,9,13,20,21,24
Aster laevis	smooth aster	Sm	28
Aster spp.	aster	Sm	5
Astragalus dasyglottis	purple milk vetch	G / Sw / A	11,12,18,20
Astragalus tennellus	loose-flowered milk vetch	Sm / G	8,10,26
Betula glandulosa	bog birch	Sw	18
Bromus inermis	awnless brome	A / G / Sm / Gm / P	4,5,8,9,10,14,15,16,24,25,28
Calamagrostis canadensis	bluejoint	A / G	6
Calamovilfa longifolia	sand grass	G	26
Campanula rotundifolia	harebell	Sm / G	8,27
Caragana arborencens	common caragana	Gm	11
Carex aquatilus	water sedge	R	1
Carex bebbii	Bebb's sedge	M	17
Carex filifolia	thread-leaved sedge	Sm / G	8,10,26
Carex spp.	sedge	P / R	13
Carex sprengelii	Sprengel's sedge	A / P / Sm	7,14,23
Catabrosa aquatica	brook grass	P / R / M U	13,17
Cerastium arvense	mouse-ear chickweed	R / M / Sm / A / G / Sw	1,2,3,5,12,18,20
Cirsium arvense	Canada thistle	R / M / Sm / Sw / P	1,2,5,13,18,19,29
Cirsium undulatum	wavy-leaved thistle	Sm / G U	10,26,27,29
Danthonia parryi	Parry oat grasss	G / Sw / Sm	11,12,18,25
Delphinium glaucum	tall larkspur	P	7,13,23,24
Disporum trachycarpum	fairy bells	A / P	6,7,22
Dodecatheon pulchellum	shooting star	M	3
Eleagnus commutata	silverberry	Sm	8,9,10,28
Elymus innovatus	hairy wild rye	A / P / Sm / Sw	6,7,9,20,21,22,23
Epilobium angustifolium	common fireweed	R / M / Sm / A / P	1,2,3,5,6,7,13,23,24
Epilobium ciliatum	northern willowherb	M	17
Equisetum arvense	common horsetail	R / M / P	1,2,13,17,24
Erigeron flagellaris	creeping fleabane	Sm / G	8,10,11,26
Erigeron glabellus	smooth fleabane	G	27
Erigonum flavum	yellow umbrella-plant	G	27
Festuca idahoensis	bluebunch fescue	G	27
Festuca scabrella	rough fescue	Sm / G / Gm / Sw / A	8,10,15,16,18
Fragaria virginiana	wild strawberry	M / A / Sm / Sw / P / G	3,6,7,9,12,18,20,21,22,24
Gaillardia aristata	gaillardia	Sm / G U	8,27
Galium boreale	northern bedstraw	M / Sm / Sw / A / P / G	3,5,6,7,8,9,10,11,16,18,20,21,22,24,25,26,27,28,2
Gaura coccinea	scarlet butterflyweed	Sm	10,29
Geranium richardsonii	wild white geranium	A / P	22,23,24
Geranium viscosissimum	sticky purple geranium	Sm / Gm	5,14,15,25,28,29
Geum aleppicum	yellow avens	R / M / P / A U	1,2,7,13,17,22,23

Geum triflorum	three-flowered avens	Sm / Sw / G / Gm / A / P	5,12,15,20,24
Habenaria hyperborea	nor. green bog orchid	G U	27
Hackelia floribunda	large-flowered stickseed	Sm	29
Hackelia jessicae	Jessica's stickseed	Sm / A	14,23
Hedysarum alpinum	alpine hedysarum	Sm / M / G / Gm / Sw / A	5,8,9,11,12,15,16,17,18,20,25,28
Heracleum lanatum	cow parsnip	Sm / A / P	5,6,7,13,14,20,23,24
Hipperis vulgaris	common mare's tail	R / stream	1
Juncus balticus	wire rush	M / Sm / P	2,3,5,13,17
Juniperus horizontalis	creeping juniper	Sm / G	8,10,11
Koeleria macrantha	June grass	Sm / G	8,10,11,16,26,27
Lathyrus ochroleucus	cream-colored vetchling	A / P / Sw	6,7,20,21,22,23
Lilium philadelphicum	western wood lily	Sw	21
Lithospermum incisum	narrow-leaved puccoon	Sm	8
Lithospermum ruderale	wooly gromwell	Sm / A / G	9,11,16,20,25,27,28
Lonicera dioica	twining honeysuckle	A / P	6,7
Lonicera involucrata	bracted honeysuckle	A / P	6,7
Mentha arvensis	wild mint	R / M / P	1,2,17,24
Menyanthes trifoliata	buck bean	R / M	1,2
Mnium sp.		R / M	1,2
Monarda fistulosa	wild bergamont	Sm	9,25,28
Nasturtium officinale	water cress	P / R	13
Osmorhiza depauperata	spreading sweet cicely	A	23
Oxytropis splendens	showy locoweed	Sm	8
Phleum pratense	timothy	M / Sm / P / Gm	3,4,9,13,15,17
Phlox hoodii	moss phlox	G	26
Picea glauca	white spruce	A / P / Sw	6,7,13,21,23,24
Poa palustrus	fowl bluegrass	M / P	2,13,17
Poa pratensis	Kentucky bluegrass	M / Sw / Sm / A / P / G / Gm / R	1,2,3,5,6,7,8,9,11,12-18,20,21,22,23,2425,27,28,29
Populus balsamifera	balsam poplar	Sm / A / P / Sw	5,6,7,13,24
Populus tremuloides	aspen	A / P / Sw	6,7,13,20,21,22,23
Potentilla hippiana	wooly cinquefoil	G	11
Potentila anserina	silverweed	R / M	1,2,3,17
Potentilla fruticosa	shrubby cinquefoil	M / Sm / Sw / G	2,3,5,8,9,10,11,12,18,26,27,28
Potentilla gracilis	graceful cinquefoil	Gm / Sm	15,25,28
Prunus virginiana	choke cherry	Sm	8,9,10,28
Pyrola asarifolia	com. pink wintergreen	A	6,22,23
Ranunculus acris	tall buttercup	M / P / R	3,13,17
Ribes oxyacanthoides	northern gooseberry	M / Sm / A / P / Sw	2,5,6,7,9,13,14,20,21,22,23,24,25,28
Rosa acicularis	prickly rose	Sm / A / P / G / Gm / Sw	5,6,7,9,10,12,15,18,20,21,22,23,24,25,28
Rubus idaeus	wild red raspberry	A / P / Sw	6,7,21,22,23,24
Salix bebbiana	beaked willow	M / Sw / Sm / P	2,5,13,14,18,21
Salix spp.	willow	R / P / G / M	1,6,12,17,24
Scutellaria galericulata	marsh skullcap	P / R	13
Senecio canus	prairie groundsel	M / Sm / G	3,8,10,27
Senecio sp.	ragwort / groundsel	M	2
Senecio vulgaris	common groundsel	P / R / M	13,17
Sheperdia canadensis	Canada buffalo berry	Sm / P / Sw / G	5,7,8,13,18,27,28
Sisyrinchium montanum	common blue-eyed grass	Sm / G / Gm	8,11,12,15,16,25
Smilacina stellata	Solomon's-seal	Sm / A / P / G / Sw	5,6,7,9,10,12,21,22,23,26,27,28
Solidago missouriensis	low goldenrod	G	27
Solidago spp.	goldenrod	G	12
Spiraea betulifolia	white meadowsweet	A / P	6,7
Stipa columbiana	Columbia needle grass	G / Sw	27,29
Stipa comata	needle-and-thread	G	27
Stipa viridula	green needle grass	Sm / G	10,12,16
Symphoricarpos albus	snowberry	Sm / Sw / A / P	5,6,7,9,10,14,18,20,21,22,23,25,28,29
Taraxacum officinale	common dandelion	R / M / A / Sm / P / Sw	1,3,6,9,13,14,17,20,21,22,23,24
Thalictrum venulosum	veiny meadow rue	M / Sm / A / G / Sw	3,5,6,9,12,14,18,20,28
Thermopsis rhombofolia	golden bean	Sm / G / Gm / M	8,10,11,12,15,16,17,27,28,29
Thlaspi arvense	stinkweed	Sm	14
Trifolium pratense	red clover	G	4,27
Trifolium repens	white clover	P / G / M	13,17,26
Urtica dioica	common nettle	A / P / M	6,7,13,14,17,22,23,24
Veronica americana	American brooklime	P / R-M U	13,17
Vicea americana	wild vetch	M / Sm / A / G / Sw	2,3,5,6,8,10,11,12,18,20,21,22,23
Viola adunca	early blue violet	Sm	5
Viola canadensis	western Canada violet	M / A / P / Sw	3,6,21,22,23,24
Viola nephrophylla	bog violet	R / M	1,2
Zigadenus elegans	white camas	M / Sm / G / Sw	2,3,8,11,12,16,18,21,27
Zizia aptera	heart-leafed Alexander	M / Sw / Sm / Gm	3,5,15,18,21

Appendix 2

Calgary Field Naturalist's Society Bird Record Project

Big Hill Springs Provincial Park - Bird sightings, 1987 to date

The following bird species were observed in or near the Park by members of the CFNS and recorded in the Bird Record Project database or in members' personal notes. Boldface entrys indicate species confirmed or evidently breeding in the Park. Asterisks (*) indicate endangered species.

Alder Flycatcher
American Coot
American Crow
American Dipper
American Goldfinch
American Kestrel
American Redstart
American Robin
American Tree Sparrow
American Widgeon
Bald Eagle
Bank Swallow
Barn Swallow
Barrow's Goldeneye
Black Tern
Black-billed Magpie
Black-capped Chickadee
Blackpoll Warbler
Blue Jay
Blue-winged Teal
Bohemian Waxwing
Boreal Chickadee
Boreal Owl
Brewer's Blackbird
Broad-winged Hawk
Brown Creeper
Brown-headed Cowbird
Canada Goose
Cape May Warbler
Cedar Waxwing
Chipping Sparrow
Cinnamon Teal
Clay-coloured Sparrow
Cliff Swallow
Common Raven
Common Redpoll
Common Snipe
Common Yellowthroat
Cooper's Hawk
Cordilleran Flycatcher
Dark-eyed Junco
Downy Woodpecker
Eastern Kingbird
Eastern Phoebe
European Starling
Evening Grosbeak
Gadwall
Golden Eagle
Golden-crowned Kinglet
Gray Catbird
Great Blue Heron
Great Horned Owl
Greater Yellowlegs
Green-winged Teal
Hairy Woodpecker
Hermit Thrush
Hoary Redpoll
Hooded Merganser
House Sparrow
House Wren
Killdeer
Least Flycatcher
LeConte's Sparrow
Lesser Scaup
Lesser Yellowlegs
Lincoln's Sparrow
Loggerhead Shrike
Long-billed Curlew
MacGillivray's Warbler
Mallard
Merlin
Mountain Bluebird
Mountain Chickadee
Mourning Warbler
Northern Flicker
Northern Goshawk
Northern Harrier
Northern Oriole
Northern Pigmy Owl
Northern Pintail
Northern Rough-winged Swallow
Northern Shoveler
Northern Shrike
Olive-sided Flycatcher
Orange-crowned Warbler
Peregrine Falcon *
Pied-billed Grebe
Pileated Woodpecker
Pine Grosbeak
Pine Siskin
Piping Plover *
Prairie Falcon
Red Crossbill
Red-breasted Grosbeak
Red-breasted Nuthatch
Red-eyed Vireo
Red-naped Sapsucker
Red-necked Grebe
Red-Tailed Hawk
Red-winged Blackbird
Ring-necked Duck
Rock Dove
Rough-legged Hawk
Ruby-crowned Kinglet
Ruffed Grouse
Savannah Sparrow
Say's Phoebe
Sharp-shinned Hawk
Sharp-tailed Grouse
Sharp-tailed Sparrow
Song Sparrow
Sora
Spotted Sandpiper
Swainson's Hawk
Swainson's Thrush
Tennessee Warbler
Tree Swallow
Vesper Sparrow
Warbling Vireo
Western Meadowlark
Western Tanager
Western Wood-pewee
White-crowned Sparrow
White-throated Sparrow
White-winged crossbill
Willow Flycatcher

Wilson's Phalarope
Wilson's Warbler
Yellow Warbler
Yellow-bellied Sapsucker
Yellow-headed Blackbird
Yellow-rumped Warbler

Mammals sighted 1987 to date:

COMMON:
Coyote
Meadow Vole
Mule Deer
Pocket Gopher
Porcupine
Red Squirrel
Richardson's Ground Squirrel
Varying Hare (Snowshoe Hare)

LESS COMMON:
American Badger
Jumping Mouse
Long-Tailed Weasel
Moose

Reptiles:
Garter Snake

Observations provided by Steven Kassai and the Calgary Field Naturalists Society, 1998.

Note: CFNS and members' wildlife sighting records often have further data including exact sites, dates, numbers, and special characteristics.

Insects sighted 1987 to date:

Butterflies:
Cabbage White
Clouded Sulphur
Common Alpine
Melissa Blue
Milbert's Tortoiseshell
Mourning Cloak
Painted Lady
Pearly Crescentspot
Prairie Ringlet
Red Admiral
Red-disked Alpine
Satyr Anglewing
Tiger Swallowtail
Western White
White Admiral
Wood Nymph

Others:
Cicada
Hawk Moth
Ichneumon Wasp
Showy Emerald Moth

Appendix 3: BIG HILL SPRINGS PROVINCIAL PARK ECOLOGICAL LAND CLASSIFICATION

Ecosite	Vegetation Physiognomy	Vegetation Community Types	Geomorphology [with unit codes]	Slope (%)	Soil Subgroups	Textures	Drain-age Class	Comments
A Anthropogenic	Unvegetated, OR sodded grounds with planted trees	Aspen and White spruce / Kentucky bluegrass	Upper alluvial fan. Coarse gravels. [Ff-i]	0-2.5	N/A	N/A	N/A	Remaining visitor facilities include paved road, gravel parking lot, toilet-garbage and picnic sites
C1 Colluvial	Grasslands (including native remnants)	Northern wheat grass - Bluebunch fescue; Sand grass - Northern wheat grass - June grass	Upper south-facing coulee wall. Colluvial veneers over till and sandstone bedrock. [Cv / M, Ri-s]	10-100	Calcareous Black, Orthic Regosol	gravelly-cobbly SiL,CL,SiC,L, LS	4	Sites 12b, 26, 27
C2.1	Mixed shrubs: Snowberry dominant; Some aspen encroachment at edges	Snowberry - Rose - Cinquefoil / Kentucky bluegrass-Brome - Northern wheat grass	Mid-to-lower coulee wall; colluvial blanket over inclined weathered sandstone. [Cv-M / Ri]	16-30	Calcareous and Orthic Black; and Calcareous Dark Brown	SiL,SiCL,L	3-4	Sites 5, 25, 29 Evidence of soil creep
C2.2	Mixed shrubs: Silverberry dominant	Silverberry - Choke cherry - Rose - Cinqeufoil / Sedge-Kenrucky bluegrass	Mid-to-lower coulee wall; colluvial blanket over inclined weathered sandstone. [Cv-M / Ri-s]	31-70	Orthic Regosol, Rego Dark Brown	rubbly - gravelly SC, SiCL, SiC,C	4	Sites 8,9,10; submesic. Evidence of soil creep
C2.3	Mixed shrubs: Rose dominant	Rose - Silverberry - Buffaloberry / Kentucky bluegrass	Lower coulee wall; colluvial veneers over inclined weathered sandstone. [Cv-M / Ri]	31-45	Calcareous Black	SiL,SiCL	3-4	Site 28; submesic Evidence of soil creep
C3	Aspen woodland	Aspen / Rose - Cow parsnip	North-facing, midslope coulee wall and ledges; colluvial blanket over inclined bedrock. [Cv-b / Mi, Ri]	31-45	Orthic and Calcareous Black	SL,SCL,SiC,SiCL	3-4	Sites 6,23
C4	Balsam poplar woodland	Balsam Poplar - White Spruce / Gooseberry	Lower north-facing coulee wall; colluvial veneer over sandstone bedrock and till. [Cv / M-Ri]	31-70	Calcareous Black	gravelly-rubbly SiCL	4-3	Site 19
C5	White spruce-dominated woodland	White spruce - Balsam poplar - Aspen / Hairy wild rye	North-facing coulee wall; colluvial veneer over sandstone bedrock and till. [Cv / Ri-s,V]	46-100	Calcareous Black, Orthic Eutric Brunisol	rubbly SiCL,SL	3-4	Site 7
CX1 Colluvial-Rock Residuum	Unvegetated, to sparse grass and scattered shrubs	Snowberry - Rose / Kentucky bluegrass - Northern wheat grass	Upper coulee walls; cliffs, sandstone outcrops; rubbly colluvium and residuum. [RXi-sMV]	46- >100	Orthic Regosols, non-soils	rubbly SL, SCL	3-4	Area of active weathering, erosion, creep, and rockfall
F1 Fluvial	Sedges with scattered willow-dominated shrub groves	Willow / Sedge	Creek channels and floodplains in Big Hill coulee. [Flo]	0-2.5	Orthic Humic Regosol	Si, SiCL	4-3	Site 1; trampled streambanks
F2	Willow-dominated shrubland	Willow - Cinquefoi l - Aspen / Kentucky bluegrass - Rush	Lower alluvial fan and streambank levees. [Ffl-t]	0-2.5	Gleyed Cumulic Humic Regosol	SiL, SCL, SiCL, CL	5	Site 2; tufa fragments in soil profile; aspen stands on creek levees
F3	Open wet meadow	scattered Cinquefoil / Buttercup / Rush - Timothy	Alluvial fan periphery; medium-textured over coarse fragments. [Ffol-i]	2-5	Gleyed Cumulic Regosol	SCL,CSC	5	Site 3; tufa fragments in soil profile; extensive cattle grazing effects
F4	Modified (reclaimed) grassland with scattered transplanted aspen and spruce	Brome - Timothy	Upper alluvial fan. [Ffl-i]	2-5	Calcareous Black	Gravelly SL,SCL,SC	3	Site 4; reclaimed campground; extensive cattle grazing effects
F5	Moist riparian meadow and woodland	Balsam poplar - White spruce-Aspen / Cow parsnip - Willow - Horsetail / Fowl bluegrass - Sedge	Floodplain and banks of Big Hill Springs Creek; dissected, undulating / terraced. [Fou-tE]	.5-5	Calcareous Black, Rego Humic Gleysol, Orthic Humic Regosol	SCL,SC SiCL, SiC,	3-7	Sites 13, 17, 24; drier regimes on knolls or terraces, moister near creekbanks. Trampled banks at some sites
F6	Open moist poplar forest with shrubs and grasses	scattered Aspen - Balsam poplar / Snowberry - Willow / Cow parsnip / Brome - Kentucky bluegrass	Fluvial terrace sequence above Big Hill Springs Creek; tufa deposits in lower ravine. [Ftl-i]	.5-15	Rego Black, Orthic Humic Gleysol	SiL, SiCL	3,5	Sites 11 (reclaimed), 14; includes relict channel, meander, and point bar in NW parcel used as pasture. F6 units mapped adjacently on ELC map reflect different terrace levels.
FL1 Fluvio-Lacustrine	Wet meadow	scattered Cinquefoil / Buttercup / Rush - Timothy	Big Hill Creek coulee (off the alluvial fan). [FLlo]	0-2.5	Rego Humic Gleysol, Terric Mesisol	CL, SiCL	6-7	Southeast corner of Park adjacent to Big Hill Creek
GF1 Glacio-Fluvial	Grasslands and tame pastures	Oat grass - Kentucky bluegrass; Kentucky bluegrass - Rough fescue; Kentucky bluegrass - Brome - Timothy	Glacio-fluvial terrace sequence above Big Hill Springs coulee, mainly to the north; gently undulating to inclined. Fluvial (or GF) veneer over till / bedrock. [GFti]	0-9	Orthic and Calcareous Black	L, SiL, SiCL	3-4	Sites 12a,15,16
M1 Morainal	Willow-dominated shrubland	scattered White spruce / Willow - Rose - Snowberry / Hairy wild rye - Kentucky bluegrass - Rough fescue	Inclined, undulating, and gullied morainal upland south of Big Hill Springs coulee; above M2. [Mbi-u-mV / R]	10-30	Calcareous and Orthic Black	gravelly-cobbly SiCL, SiC, C	4	Sites 18, 21
M2	Aspen woodland	Aspen / Rose - Snowberry	Upper north-facing rim of Big Hill Springs coulee; morainal blanket. [Mbi-uV / R]	2-15	Calcareous Black	SiCL,SiC,C	4	Sites 20, 22. Some aspen-encroached grass & shrub sites.

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